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Special edition: The impact of neurobiological sciences on family placement policy and practice

Guest Editorial

The diverse neurobiological processes and legacies of early adversity: implications for practice

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Articles

- **Jackson, N., & Burke, K**. (2019). Attitudes to and experiences of genetic information and testing among professionals working in the context of adoption. Adoption & Fostering, 43(3), 256–273. https://doi.org/10.1177/0308575919864187
- **Oliveira, P., & Fearon, P**. (2019). The biological bases of attachment. Adoption & Fostering, 43(3), 274–293. https://doi.org/10.1177/0308575919867770
- **Pinto, C.** (2019). Looked after and adopted children: applying the latest science to complex biopsychosocial formulations. Adoption & Fostering, 43(3), 294–309. https://doi.org/10.1177/0308575919856173
- **Gerin, M. I., Hanson, E., Viding, E., & McCrory, E. J.** (2019). A review of childhood maltreatment, latent vulnerability and the brain: implications for clinical practice and prevention. Adoption & Fostering, 43(3), 310–328. https://doi.org/10.1177/0308575919865356
- **Baldwin, J. R., & Danese, A.** (2019). Pathways from childhood maltreatment to cardiometabolic disease: a research review. Adoption & Fostering, 43(3), 329–339. https://doi.org/10.1177/0308575919856175
- **O'Connor, T.G., & Vallejo Sefair, A.** (2019). Stress and physiology in clinical research with risk-exposed children: from mechanism to application. Adoption & Fostering, 43(3), 340-350. https://doi.org/10.1177/0308575919856162
- **Sellers, R., Smith, A., Leve, L. D., Nixon, E., Cassell, J., & Harold, G.** (2019). Utilising genetically informed research designs to better understand family processes and child development: implications for adoption and foster care focused interventions. Adoption & Fostering, 43(3), 351–371. https://doi.org/10.1177/0308575919866526

[Guest editorial]

The diverse neurobiological processes and legacies of early adversity: implications for practice

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[H1] Introduction

We are grateful for the opportunity to edit this special edition of *Adoption & Fostering* on the neurobiological aspects influencing the mental health needs of looked after and adopted children and young people. The impetus for this in part grew out of an earlier article in this journal that gave an overview of the complexity and interrelatedness of some of the domains that influence the neurobiological legacy of early maltreatment, especially with regard to the common misunderstandings and over-simplified messages which have tended to obscure the individual differences in maltreated children and make them sound more similar than different (Woolgar, 2013).

This collection of seven articles represents an updated and more in-depth review of current thinking across the range of possible neurobiological legacies of early maltreatment and neglect and their impact on practice. In so doing it highlights the complexity of this area, and the challenges for translating these important and rapidly developing fields into our thinking about looked after and adopted children. We also hope that this collection of papers could act as a reference and a resource for a practitioner faced with a biologically framed hypothesis or plan about a child or young person, that seems to be not about this particular child or young person as they are, but more about some average, generic or hypothetical maltreated child.

The biological sciences investigating the legacy of early negative experiences for children and young people have already influenced significant policy decisions and guidance, and alongside that debates within the social care practice arena, most notably to do with the early intervention initiatives. Planning and decision-making for children where their parents are

struggling to provide safe and adequate parenting are undoubtably challenging, troubling and hugely significant. Children are highly dependent on their parent/s for their basic survival although that changes as they develop degrees of physical and psychological maturity and independence. But maturity and independence are not sufficient protections in themselves as the experience of abuse and neglect demonstrates at whatever age. Domestic violence has become clearly identified as a serious risk factor for children and adults who are subject to or witness such abuse. The basic ability of an adult to protect themselves in such situations and take action to do so can help. However, the identification of 'coercive control' in adult relationships has highlighted the complexity of taking protective steps in such circumstances. For children and adolescents, the ability to leave abusive and/or neglectful situations is almost impossible. This reinforces the importance of the State being able to take protective action whether that is providing proactive support to parents through the provision of services or proactive action to remove children from high risk families. The child's right to a safe, protective, respected and enabling family life is clearly set out in law as a court's 'paramount consideration' when it is determining any question with respect to the upbringing of a child.

The impact of neuroscience on family placement policy and practice is substantial and at the same time, highly controversial. It is a primary concern for every parent to ensure that their child develops to their full potential. That is also an enormous challenge as there are typically 24/7 questions posed for parents about 'what the right thing to do is in a specific set of circumstances. There are a vast range of views about parents finding the 'right solution' - different models of parenting, having access to the right resources, having the personal capacity to respond to the unknown and problem solve, and in addition individual qualities such as sensitivity and the capacity to think, feel and respond to the child over time. Much of this suggests a significant degree of control on the part of the parents, but in many of these circumstances, control is elusive or problematic. And these issues are frequently are at the heart of what social workers become involved in – parents that are significantly struggling to provide their children with what they need and children whose welfare and development is under varying degrees of threat. How social workers come to explain what is going wrong and what they should do about it are long standing challenges to the profession. There are well established explanations of underlying features such as attachment or trauma impacting on parenting. There are also specific, commonly reported issues such as parental drug or alcohol misuse. But the challenge is knowing what influences what and then what is effective at addressing the issue as identified. These are very serious issues when the

consequences of what might happen next is the forceful removal of a child in either the short term or perhaps forever. And as a part of that journey there will be the evidence on these matters as they are presented to court and the court's interpretation of its weight and significance in its administration of justice.

In such complex situations where the challenge is huge and consequences life changing, colourful pictures of brain architecture have an objective appeal when faced with the challenge of making day-to-day sense of a child's emotional, behavioural and social issues. Neuroscience can be seen to root uncertainty and anxiety into a set of scientific explanations that are reassuring when they resolve the challenge of uncertainty and the anxiety that can accompany this. Connecting these brain images to other anatomical features such as the Hypothalamic-Pituitary-Adrenal (HPA) axis and then the impact of the stress response associated with cortisol, gives further reassurance. When this is amplified by video material that show neural connections being or not being made or the pathway of cortisol across the HPA axis, we are into a whole different explanatory world that eases the pain of the very difficult decisions that lay at the heart of both care proceedings and placement plans. But while these explanations and perspectives may be confidence boosting, they have also been subject to intense criticism as they are seen to minimise the impact of factors such as inequality, poverty and austerity on families and replace this with a scientific lens through which to interpret human behaviour.

These issues were played out in a very intense challenge to the publication of the Department for Education funded evidence review (Brown & Ward, 2013) which had the support of the Family Justice Council. The President of the Family Division commended the publication in the foreword:

[QUOTATION]

> I am confident that this excellent research summary will prove invaluable as an aid to our understanding of the child's developmental journey, providing up to date material regarding the impact of adversity on child development, and the likely outcome for the child. I commend it.

[QUOTATION ENDS]

The subsequent challenge was set out in a seminar at Edward Lloyd-Jones' chambers in May 2013 followed by an article in Family Law (Lloyd-Jones, 2013). This was further developed

in three on-line papers (White and Wastell, 2013) and a journal article (Wastell and White, 2012) where the authors summarised their objections to the earlier publication (p. 399):

> [QUOTATION]
> We argue that the neuroscientific claims supporting current policy initiatives have received little critical commentary. They appear to be operating as powerful 'trump cards' in what is actually very contentious terrain, suppressing vital moral debate regarding the shape of state intervention in the lives of children and families.
> [QUOTATION ENDS]

The impact of this intervention was significant and subsequently a detailed response was published by the original authors (Ward and Brown, 2013) who wrote (p.1185):

> [QUOTATION]
> Like our critics we are well aware that current neurobiological research could be misrepresented to inform policies that may damage families (for instance by feeding into the political discourse about *'strivers and skivers'*). However, it is not appropriate to attempt to discredit research because it could be misused in this way.
> [QUOTATION]

But unfortunately, this had the effect of diminishing the status and authority of the original published document as practitioners in law and social work could not resolve these complex questions in their day-to-day practice. It also did not ease the challenge making decisions about children living in seriously challenging circumstances where an evidence base is critical: the issues of making sense of what was happening to them and what should be done to ensure their right to a life safe from harm and to decide what is in their best long term interests remain.

Part of these problems arises from seeking a balance between simplification of a complex area to be able to share important ideas with a wide audience, against paying sufficient attention to the nuance and complexity of a rapidly developing area. Simplifications can lead to practitioners over-estimating the extent of their knowledge at the expense of an openness to nuance in expert opinion (Scharrer, Rupieper, Stadtler, & Bromme, 2017) and this appears to be particularly true for neurobiological data, and especially where images such as brain scans are used in court settings (Baker, Ware, Schweitzer, & Risko, 2017). Indeed, there is

much more than can be said in this selective collection about the rich diversity of scientific understanding in this area as it incorporates research into a range of biological domains and is growing year on year. As a result, many practitioner-level presentations of the science are not only simplified but grossly simplistic; they have not embraced the diversity and range of the constantly emerging findings, or indeed the nuances of their application to the areas of adoption and fostering, as well as the unintended consequences of such a partial scientism, especially when they still rely on publications from the last century, such that '…today's neuromyth is based on yesterday's cutting edge science' (Rose and Rose, 2016: 122). For example, considering the innovations in neuroscience alone, there was a steady increase in the number of academic articles published in this field between 2006 and 2015, with almost 40,000 articles in 2015 alone, and approximately a quarter of them were in the fields of psychiatry, psychology and the behavioural sciences (Yeung, Goto, & Leung, 2017). It is not feasible for practitioners to keep abreast of all these developments and innovations in an area that continues to increase rapidly in both absolute and proportional terms.

Leading developmental scientists tasked with investigating how the new and emerging sciences have been translated from primary research and into the public understanding have cautioned that '…the substantive content of the science was often misinterpreted or misrepresented…' (Shonkoff and Bales, 2011: 18). This had implications not just for the way children are understood, but also the way they are treated:

> [QUOTATION]
> It is currently fashionable to extrapolate from basic brain research on these [maltreated] children to the hyperbolic conclusion that they are damaged goods who are extremely difficult to redeem. One of the opinions offered about these children is that regular treatments do not work and that therefore unconventional, highly intense, radical, risky, and coercive treatments are required to avoid dire outcomes. This clinical lore, almost completely untested, has been a foundational assumption legitimizing the use of concerning treatments. It is an opinion lacking scientific support and in fact appears to be an opinion increasingly contradicted by the available scientific evidence. (Chaffin, 2008: 313)
> [QUOTATION ENDS]

Not only has the impressive and innovative biological sciences related to the early adversity, maltreatment and neglect been misunderstood outside of specialist journals read by specialist researchers, but there have also been significant implications for the ways in which maltreated children's individual needs have been obscured and their access to effective interventions blocked as a result of that misunderstanding.

This is a shame because the biological legacies of early maltreatment, neglect and adversity are fascinating, but they are also complex and interdependent, a feature that we hope this compendium of articles will demonstrate. While it might be difficult to identify a single, purely scientific take-home message from this collection (e.g. one that could be applied to every child), we propose that the organising theme should be about keeping individuality in mind; that *early adversity breeds diversity in outcomes* and does so for good, biological reasons. And this cannot be stated too often given the concerns about the simplification of early adverse experiences into common or average experiences, at the expense of individuality and sometimes without considering individual level vulnerability and resilience factors. Or, indeed, in seeing the cohort of adopted or looked after children as all having 'trauma' or 'attachment' issues in a way that is so broadly construed that these important terms lose their meanings. Of course in the UK, specifically within England, evidence for this can be seen at the policy level in the Department of Education's decision to use the Adoption Support Fund only to support assessments and interventions that address trauma and attachment issues (www.first4adoption.org.uk/adoption-support/financial-support/adoption-support-fund/) – something that is out of step with the idea of diversity of outcomes following early adversity (Cecil, Viding, Fearon, Glaser, & McCrory, 2017; Weissman, Bitran, Miller, Schaefer, Sheridan, & McLaughlin, 2019). Indeed, the negative consequences of importing only partially thought through biological constructs into social policy and practices have been discussed in detail elsewhere (Wastell and White, 2017 [reviewed in the journal]).

[H1] Environmental differences in adversity

Overall, the issue is one of keeping in mind the individuality of looked after and adopted children, recognising that while there are good biological reasons for this, even before we get into biology, there are also good reasons when we think about the social phenomenology of early childhood adversity. The diversity of presentation and the personalised nature of their needs come firstly from the fact that the population of looked after and adopted children will

have had very different early experiences at the individual level. Even if much research tends to focus on the impact of one type of maltreatment at a time, children and young people's real-life exposure is typically characterised by overlapping forms, to produce distinct exposure clusters (Cecil et al, 2017). Moreover, even children raised in the same families are likely to have had divergent and individual experiences of early maltreatment and neglect, alongside their common experiences: one child scapegoated, another favoured, etc.

This difference in the kinds of salient early adversity needs to be kept in mind, especially in the face of the increasing popularity to derive a summary score of adverse childhood experiences (ACEs) across different types and forms of experiences (Steptoe, Marteau, Fonagy, & Abel, 2019). The ACE framework is such a popular approach now, even though there are notable problems with translating aggregate information derived from large-scale studies on specific populations – which may well be useful to inform, but not determine, social policy – into the case formulations of individual children's experiences (Kelly-Irving & Delpierre, 2019). Knowing something about how much of generally bad stuff might increase the need for, say, physical health provision at a population level, remains a long way from saying something meaningful about an individual child's experiences and their current needs. Then beyond the issue of aggregating kinds of maltreatment type, there will be further unique effects associated with a range of other factors, including but not restricted to, age of exposure, duration, severity and perpetrator, as well as the presence of other external resilience factors that might mitigate, promote and personalise those experiences, including subjective perceptions of threat associated with the different kids of experiences in different individuals.

As noted above, maltreatment types and forms of early adversity tend to be highly correlated, and unsurprisingly the more types a child has been exposed to the worse the average outcomes (Finkelhor, Ormrod, & Turner, 2009; Lauterbach, & Armour, 2016), but at the same time there is increasing evidence that the consequences of maltreatment do not load onto a single type of poor outcome, be it trauma or attachment difficulties, or some other global account of outcomes, but rather that underlying transdiagnostic processes are affected, and these can lead to quite different forms of ultimate mental health issues (Weissman et al, 2019; McCrory & Viding, 2015), so we would expect children exposed to early maltreatment to present in quite different ways with personalised needs and therefore different kinds of indicated interventions.

[H1] Biological differences in adversity

Second, even if we gloss over the inevitable differences in lived experiences in the early environments for children exposed to similar types of maltreatment - if we simplify our thinking sufficiently to assume that, for example, neglect in one family is sufficiently similar to neglect in another family - then even so, we would still expect these children and young people to have a range of possible outcomes, and this is where a biological framework can be helpful. We can see evidence for this in both human and analogue animal studies.

The experiences of several cohorts of institutionalised children who were growing up in Ceausescu era orphanages in Romania have been studied in the UK and the US when their circumstances changed to either adoption or foster care (Rutter, Beckett, Castle, Kreppner, Stevens, & Sonuga-Barke, 2009; Nelson, Fox, & Zeanah, 2014). The common factor here was the extreme levels of neglect, typically in the absence of other (catalogued) forms of maltreatment. High levels of extreme neglect had strongly measurable impacts on child outcomes, in ways that related to dose (in the sense of timing and/or duration of exposure) but even so, there were marked individual differences in outcomes. Take for example the case of attachment in the children adopted into the UK from Romania. There was a very clear effect of institutional neglect on attachment compared to UK adopted children, and one that varied with duration (i.e., when they were removed from the institution and adopted) – but, still there were children from the institutions who were securely attached to their adoptive parents. Indeed, the commonest attachment pattern was secure in those adopted early (41.5%) and was relatively common even in those adopted later (33.3%) (O'Connor, et al, 2003).

If we look at analogue animal studies, the evidence for diverse process and varied outcomes is even clearer, as it has been possible for scientists to manipulate the form, quality and duration of early neglect so that samples of, for example, monkeys have had highly equivalent early negative environments. Again, among a general picture of a significant legacy of early negative experiences on later outcomes, there is still strong evidence of individual differences in the extent of disorder vs adaption which cannot be attributed to differences in lived experiences (Stevens, Leckman, Coplan, & Suomi, 2009). Indeed, several of the identified mechanisms that explain diversity of outcomes in monkeys, of risk and resilience profiles, share biomarkers with humans (Suomi, 2008), some of which are discussed in the subsequent articles. We ought to expect that early adversity leads to a

diversity in later outcomes, even when that adversity is experimentally controlled to be as equivalent as possible. There will still be a mix of problems and adaptations distributed through various biological, psychological and social systems.

With that in mind, the following seven articles collect together work across multiple domains of biopsychosocial systems that have been shown to be implicated in diverse ways following early negative experiences and also consider their application to practice. But our collection here does not claim to be comprehensive, there may be other systems involved and other issues in terms of clinical practice that could be elaborated, but these articles highlight the complexity of the picture and raise many issues that practitioners should know about when considering the needs of looked after and adopted children. These papers illustrate that there is powerful and innovative neurobiological research being conducted, across a range of domains, highlighting the complexity and inter-relatedness of these systems, and then there ethical and practical questions about how emerging biological sciences are ready and able to make their way into practice.

The papers

Genetic testing

The genetics talked about in **Jackson and Burke**'s article differ from the behavioural or quantitative genetic studies of individual differences in behaviours described in detail by Sellers and colleagues, here being about specific syndromes or diseases with a genetic aetiology. For many practitioners the different senses of the genetic processes between the two may well be blurred. To help with this Jackson and Burke's article is in two parts. First it presents an overview of chromosomal disorders and some of the techniques used to assess them. Then there is an investigation of the professional and ethical implications for practitioners (social workers and medical advisors) of genetic testing for chromosomal disorders – a technique that is becoming an increasingly common for looked after and adopted children's health profiles.

Many practitioners will be aware of chromosomal disorders such as Trisomy 21 (Down's syndrome), a non-inherited genetic disorder, and perhaps Fragile X, an inherited genetic disorder. Some chromosomal disorders are relatively straightforward to assess for in terms of presence or absence, but Jackson and Burke also describe emerging techniques that look beyond specific target genes at the quality of the overall genetic material to see if there may be anomalies at a more general level. These latter approaches are currently less definitive

than single gene testing and that uncertainty opens up issues of ethics, because while this may indeed provide useful information, there are questions as to what to do with that knowledge and who can give consent for an investigation in looked after and adopted children that may well have implications for later generations.

Genetic testing can be a part of the initial health assessment of the child and can be important to prospective adopters when making a plan for the child. At the same time, the precise significance of what is discovered can be challenging to families (and their advisors) when making life long decisions based on this information – especially as these new techniques can generate uncertain results or unexpected findings. The qualitative study looks at the ethical challenges for genetic testing in this cohort, and how much knowledge social workers and health practitioners currently have about these issues. These practitioners were worried about these uncertain results, and how to feedback such information to children and prospective carers in a helpful way, and indeed expressed particular concerns about whole genome testing approaches. For this cohort there are issues about who receives this information amongst birth family, professionals and/or prospective carers. But it seems especially important for birth families, as findings in a child could mean that others in the genetically related birth family, across generations, may receive information that indicates further testing or highlights concerns about their own health and well-being.

The biological bases of attachment

Attachment is central to thinking about adopted and looked after children's experiences and the article by **Oliveira and Fearon** highlights that attachment is also a 'profoundly biological' system that captures and represents those experiences, but does so in relation to genetic factors as well as neurobiological and hormonal responses.

In terms of measures of attachment quality indexed through attachment patterns, Oliveira and Fearon highlight that there is very weak evidence of a direct effect of genes. Attachment patterns seem to be very much a function of the specific environments that children grow up in and their experiences within them, especially earlier on in life; and this lack of a clear heritable component for attachment patterns is unusual in developmental psychology research. However, genetic effects have more evidence in terms of shaping *individual differences* in response to adverse rearing environments, with some children being more or

less susceptible to developing insecure or disorganised attachment patterns or, indeed, attachment pathology in the context of high-risk and maltreating environments.

Oliveira and Fearon also discuss the role of attachment and physiology – and one of the most interesting and longstanding findings in the Strange Situation Procedure is of insecure-avoidant infants manifesting a minimised response to their caregivers' return - when they would be expected to be maximally stressed and in need of their attachment figure; but this hides an internal, physiological turmoil, as they cope the best they can with a caregiver with a history of insensitive parenting. The insecure-avoidant infants are stressed but managing to get their attachment needs met as best they can, given their previous attachment-related experiences with that caregiver – they are fitting to their attachment needs into their prevailing environment as best they can. Furthermore, the quality of attachment can influence the HPA stress response system (see also O'Connor & Vallejo Sefair; and Baldwin & Danese, this issue) as indexed via cortisol and, after infancy, the development of a secure attachment relationship could help to buffer children who are temperamentally vulnerable to the negative consequences of stress.

Attachment quality is strongly influenced by environment, but its variation in quality is associated with biological markers in the brain, physiology and also genetics, including the processes discussed in this issue by Sellers and colleagues, O'Connor and Vallejo Sefair and Gerin and colleagues. Indeed, high quality attachment-based interventions have shown that improvements in attachment relationships can be accompanied by improvements in biological markers such as cortisol. Interestingly, while there has been a relatively developed literature on adult attachment patterns and brain imaging, Oliveira and Fearon highlight that the findings for early attachment and brain imaging is 'scarce', with the exception of disinhibited attachment pathology in institutionalised children. This may surprise some readers familiar with secondary or tertiary texts that link poor early attachment quality to, say, smaller brains. Oliveira and Fearon point out that where the brain basis of attachment has been studied, results do not indicate a specific region (or gross size of brain) but rather, in line with Gerin and colleagues' article, that distinct brain circuits and their functions, such as reward processing and emotion regulation are implicated.
[QUOTATION]

> "Although attachment bonds are widely believed to result from universal, innate "attachment behavioural system," attempts to locate a single, dedicated attachment circuit is likely to be (to paraphrase Wittgenstein) a bit like trying to find the real artichoke by peeling away all its leaves." (Coan, 2016, p243).

[END QUOTATION]

Applying the latest science to complex biopsychosocial formulations

No account of the neurobiological legacy of early maltreatment would be complete without consideration of the practical implications for the mental health practitioner faced with a child with a history of adverse early experiences. The article by **Pinto** presents a case study of an adopted young person who was assessed in a national specialist mental health service for adopted and looked after children, but who had been assessed many times previously and, from those prior assessments understood wholly within an attachment framework. This article presents a clinician's perspective of integrating biological issues into mental health assessments, as part of a biopsychosocial framework, for a client group in which thinking is frequently dominated by a one-size-fits all attachment and/or trauma framework. For the child in question, previous assessments had missed a range of specific mental health problems that had led to poor management, a lack of interventions, inappropriate educational provision and on-going stress in the family.

The article also highlights some of the challenges for translating the emerging, highly complex and domain-specific scientific models into practitioner settings, beyond: (a) being aware that there are multiple factors out there beyond manifest post-natal negative experiences; (b) that headline experiences may not be the most salient cause of current problems or necessarily the most helpful focus of intervention; and (c) in the light of this, the importance of a personalised approach that attempts to unpick the confounding factors. Indeed, clinical guidance has long recommended that the assessments of children with histories of maltreatment and neglect, and who may have attachment issues, should be based around detailed multidisciplinary assessments leading to comprehensive biopsychosocial formulations (Chaffin et al, 2006).

In this case, the child's formulation prior to a comprehensive biopsychosocial assessment had been based on solely environmental factors, specifically only upon attachment, with no account of *any* biological processes. Indeed, in Pinto's case study there were other biological issues than the ones presented in this special issue that also needed to be address, including in

utero opiate exposure and physical health problems and disability. While there may still be a long way to go to be able integrate the full range of biological factors into routine practice of understanding children with complex histories, there already is a lot that can be achieved using existing knowledge that goes behind a purely environmentalist account of problems.

A review of childhood maltreatment, latent vulnerability and the brain

The next article in this collection considers how negative early experiences get inside the head (rather than under the skin cf Baldwin and Danese; O'Connor and Vallejo Sefair, in this issue). The brain is a complex system, not a single entity, and to help readers recognise that **Gerin, Hanson, Viding and McCrory** highlight the impact of early negative experiences on four neurocognitive systems known to be affected by maltreatment and neglect (threat processing, reward processing, emotion regulation and executive control) and also to be implicated in later mental health. In so doing they focus on the neurocognitive *functions* altered by negative experiences, things that more directly help us understand what the practical and on-going impact might be on the child's development, rather than on the volume or morphology of brain structures or regions, which are less helpful, despite being very common in the popular understanding of the impact of early adversity on outcomes (e.g. Allen, 2011). The cutting-edge brain science presented in this article is certainly not about dramatic pictures of scans purporting to compare a normal brain and a tiny one, side by side. Rather, by focusing on the functional aspects, Gerin and colleagues consider how the systems within a developing child's brain help them to make sense of the world, for example, how these functions might be able to rapidly process types of information or make predictions (jump to conclusions), as a way of functionally *adapting* to the environment he or she finds themselves in, where being able to do these things quickly and efficiently could be very useful.

Gerin and colleagues' article also highlights that because the brain is a composed of different systems and functions, these can be altered in various ways by different types of experience and so it is not surprising that there is not one specific neurocognitive legacy, nor certainly one specific type of mental health disorder that is likely, let alone guaranteed, to follow from early adverse and maltreating environments. Rather, they present a pattern of risk processes in the framework of latent vulnerability (McCrory & Viding, 2015). The central idea here being that the neurobiological legacy of early maltreatment represents 'recalibrations' or adaptations to the prevailing negative environment, rather than damage done, and these

adjustments to the environment are functional at the time and permit the child to do the best they can in the short term, but at a potential adaptive cost downstream, later on in development. These costs, being latent do not map onto specific illnesses or disorders, but may well emerge into pathology down the line, as the consequences of the various challenges that they pose to adaptive functioning accrue over time.

Following from this, as it is likely that different children will have different neurocognitive subsystems differentially affected, even in the context similar types of negative experiences, preventive interventions would need to be tailored to the individual child's pattern of neurocognitive (mal-) adaptations (as well as an understanding of their broader biopsychosocial formulation). This has implications for interventions claiming to be guided by neuroscience (of which there are an increasing number), not least that there are unlikely to be one-size-fits-all approaches that any child who has experienced maltreatment ought to have.

Pathways from childhood maltreatment to cardiometabolic disease

It is commonly understood in the practitioner world that when children are exposed to early adversity their *body might keep the score* or that experiences *can get under the skin*, such that the impact may not just be on overt mental health, but that environmental experiences can cross over into a legacy for the body. The next two articles consider two elements of this in detail. The article by **Baldwin and Danese** carefully unpacks what that might mean for adopted and looked after children's physical health, specifically in relation to cardiovascular disease and diabetes, and the biological processes that seem to drive them, including obesity and the immune system.

Interestingly, the legacy of early negative environments (and currently the evidence is that the form of the maltreatment or neglect is not specific) for risk of obesity seems to lie fallow and only emerge later on in adulthood, after an 'incubator period'. Even after various potential explanatory factors are taken into account, including childhood weight, birth parent BMI, SES, education, etc. Practitioners will know that many looked after and adopted children are described has having issues with food and appetite, but the mechanisms proposed in this paper are complex, linking together a tendency to eat more, and do less, due to neuropsychological aspects, such as reward processing/executive function (perhaps not

detecting when full) as well as behavioural features (inactivity) possibly arising from low mood but also inflammation factors.

And as a theme running throughout several of these articles, both a tendency to weight gain and also to elevated inflammation processes, could each be adaptive response to the experience of an early hostile environment, for example, as protection against malnutrition and a preparedness to cope with injury and illness; in this instance with maladaptive and cascading effects on later physical health including heart disease and diabetes.

Baldwin and Danese report that interventions to help these children with poor physical health have not been tested, but they highlight potential multifactorial contributors to effective approaches, which are not psychological in the sense of a traumatic memory of having been deprived. Imagine a carer who responds to the child's perceived deprivation of food when they were little, with a reparative approach of compensating with as much food as a child wants to challenge that 'feeling' or memory of deprivation; this might inadvertently reinforce an inability to detect when the appetite is satiated and thereby maintain unhealthy eating habits in the absence of any mechanism to do with psychological deprivation or memories. Rather, effective interventions may need to follow from integrated multidisciplinary assessments in which mental, social and physical health is considered holistically, and Baldwin and Danese report there is already some evidence for joining up physical and mental health approaches for reducing risks.

Stress and physiology in clinical research with risk exposed children

Probably the most widely known stress biomarker is the so-called 'toxic stress' hormone of cortisol, which **O'Connor and Vallejo Sefair** discuss in detail. They situate cortisol as part of a complex system; a 'downstream element of the HPA axis'. Cortisol is an *indicator* of HPA (HPA: Hypothalamic-Pituitary-Adrenal) axis activity, which might be elevated by stress, but cortisol itself is neither a direct nor uncomplicated measure of stress, not least because it is also involved in a variety of other bodily functions and the HPA axis is also integrated into other biological systems, including the autonomic nervous system and the immune system (see Baldwin and Danese, this issue) and of course it links brain regions (e.g. the hypothalamus) to the other systems in the body (i.e. the pituitary and adrenal glands).

This makes the research on cortisol, as a primary and proximal measure of 'toxic stress', much more complex and nuanced than many secondary or tertiary texts present. Moreover,

there is a natural variation of cortisol over the day – for example, the surge in the morning that helps us get out of bed – so temporary high levels of cortisol are effective, necessary and quite normal outside of threat contexts. Indeed, of the indicators that could be used to measure the underlying biological systems implicated in the HPA axis, O'Connor and Vallejo Sefair highlight that the selection of cortisol may have had less to do with its scientific primacy in the stress system and more because is it easier to measure than the other hormones that occur earlier on in the system. That cortisol has been studied because it is easier collect brings with it some subtle methodological issues about what exactly is being measured. Behind cortisol as 'toxic stress' are a series of complex and connected biological systems, and the meaning of the 'cortisol' research differs depending on the methods used and, again, is much more varied than most practitioners' understanding of toxic stress allows.

O'Connor & Vallejo Sefair also describe how the over and under activation of cortisol related responses to stress are interesting, but again complicated, and there is no reliable mapping between these different types of cortisol profiles in childhood and specific psychopathology later on. However, there have been complex relationships revealed between institutionalisation and cortisol / HPA profiles, and a number of human and animal studies that support the idea of *in utero* programming effects, such that maternal experiences of distress during pregnancy can prepare the foetus, via alterations in the functioning of the HPA axis, for the kinds of environment that they may be expected to fit into. In discussing these studies, O'Connor and Vallejo Sefair make a broader point about the challenges of integrating the science of cortisol and indeed other biomarkers into translational clinical practice and social policy.

Using genetically informed research designs to better understand family processes and child development

Finally, the article by **Sellers, Smith, Leve and colleagues** demystifies some of the terminology and the methods by which researchers seek to disentangle the effects of genes and environments and their relation to person-environment processes (e.g., Rutter, et al., 2007). Indeed, some of the most powerful genetically sensitive research designs are adoption studies as these can control for some of the genetic overlap between parents and their birth children. This is important because genetic influences can become side-lined in some practitioners' understanding of the neurobiological legacy of maltreatment and neglect – in part perhaps because of anachronistic concerns about genes and destiny, especially in relation to concerns about IQ and opportunity. Rather, as this article makes clear, the study of

behavioural genetics, keeps taking us back to environments, and also to the theme running through this special edition, that individuals are different.

Sellars and colleagues describe what genetic studies can tell us about the role of environments in development for all children and they present many examples of how genes and environments are deeply intertwined in important ways; for example, how genetic designs can help to shape our understanding of what it is to care for a genetically unrelated child, e.g., to be a foster carer or an adoptive parent. Sophisticated studies have demonstrated that genetic factors can have a hidden legacy on later child and parent functioning; for example how heritable features of the birth mother's psychopathology can have an impact on an adoptive mother's parenting by way of genetic influences on the child's behaviour that can elicit or evoke negative parenting practices – perhaps a form of action at a distance. Importantly for practitioners, this could apply even for an infant adopted at birth, in the absence of manifest post-natal negative experiences or exposure to foetal toxins, etc., so that what might be seen as poor adoptive parenting in the context of low risk, could be better understood as characteristics of the birth mother's mental health and well-being casting a shadow over the adoptive parenting environment, emerging through the transactions between inherited characteristics of the child and their adoptive parent, in the absence of any manifest attachment or trauma issues.

Also, with regard to treatments, firstly, genetic information from genetically informed studies could help practitioners personalise their advice to parents and carers to prepare them for the kinds of heritable traits that *could* challenge their parenting skills. Secondly, Sellers and colleagues discuss the genetic influences that can lead to children being more or less susceptible to their environments, and not just in terms of vulnerability to negative environments, but also to recovery in positive ones and with their response to interventions.

[H1] Conclusions

It will be clear from these papers that there is a vast amount of research lying behind the various claims of the developmental importance of early maltreatment and neglect for later outcomes in adopted and looked after children. That there can be a legacy from early negative experiences is a robust finding across studies in different biological domains, but the way these legacies have been translated into some social policies, and into practitioner guidance, are not without problems, and have led to some fierce debates. Without getting into those

debates here, we would argue that there are not fundamental problems in the science itself, so much as with its understanding and use.

Take for example the pervasive idea that negative early experiences from conception to the first few years has an especially damaging effect on the brain. First, the papers in this special issue highlight that the biological legacies are not restricted to only the brain, and second that the idea of 'the brain' as a thing that gets damaged (or even worse, stunted in some way) is a grossly unhelpful simplification, even if it is an idea that is easier to pitch to policy makers or could help drive model adherence in practitioners (Edwards, Gillies, & Horsley, 2015). In fact, the brain performs very different functions, and these can be differentially affected. And such additional detail, missing in most secondary texts translating ideas into practice are also the case for the other biological areas of study discussed here. There are processes and mechanisms at work, inter-relating across domains, that are still being uncovered and not yet definitively understood, but it is clear that these impacts, where they occur, are diverse and irreducible to affected brains.

In terms of these mechanisms, a recurring theme through this collection is the idea not of damage done early on, but more that biology responds to early hostile environments with some kind of adaption; the best fit an individual can manage. There is accumulating evidence for this, and it is a convincing framework for thinking about children for whom early negative experiences cast a shadow over their later development; but these mechanisms are still largely hypotheses, albeit with a degree of evidential support, that will need further studies to test out and refine our understanding of how the mechanisms could unfold over development. Across the different neurobiological systems, a child in a hostile environment might find themselves more or less fitted (i.e., suited) to the maltreating environment they find themselves in, but which may leave them more or less unfitted (i.e., unsuited) to a later environments, including less maltreating ones. Behind these patterns of adaptive and maladaptive fit are a complex set of possible neurobiological factors interacting with personal experiences and the on-ongoing environment (where environment can encompass both the proximal family environment, as well as the more distal socioeconomic ones). For now, the idea of adaption or fittedness to the prevailing environment certainly provides a much more scientifically convincing argument for the way in which early negative environments might have an effect, than some common, early, unrecoverable damage.

And the sense that a child 'might' show some kind of (mal)adaptation to their environment is crucial, as a further theme throughout has been the importance of individual differences. Even if there is some work that is establishing the kinds of outcomes that forms of maltreatment or neglect can have on average, it is also clear that not all children respond in the same way. The biology emphasises that there is no typical maltreated child, no certain outcome and no off-the-shelf, one-size-fits-all answers for thinking about the legacy of early maltreatment and neglect. Instead complex children require comprehensive assessments open to the impact of biological, psychological and social factors to best capture their individuality.

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